Attachment: Delivery Documentation for the Updated RXTE Star Catalogs

This memorandum documents the analysis and quality assurance completed to produce the recently regenerated RXTE ground and on-board star catalogs. In addition, the report provides mission specific information such as the ground and on-board catalog formats and detailed descriptions of the ground catalog and on-board catalog quality flags. It also includes comparisons of the contents of the updated ground and on-board catalogs with those of the pre-launch ground and on-board catalogs.

INTRODUCTION

The original ground star catalog for RXTE was generated using the SKYMAP System (an input Master Star Catalog and the mission star catalog generation program MMSCAT) prior to the launch of RXTE on December 30, 1995. The Master Catalog (MC) used was Version 4.0 of the SKYMAP Master Catalog. The resulting ground star catalog contained 32,516 entries with a predicted limiting instrumental magnitude of +7.0. At that time, the sensor resolution used in MMSCAT for RXTE's two Ball CT-601 charge-coupled device star trackers (CCDSTs) was 2.0 arcseconds, so that separate ground star catalog entries would be retained for stars separated by more than 2.0 arcseconds.

The original on-board star catalog (OSC) for RXTE was generated in part (for astrometric, photometric, spectral type, and variability data) from the SKYMAP Version 3.7 MC, which predated the major revisions made to the MC to create the Version 4.0 MC used to produce the pre-launch ground star catalog. The predicted instrumental magnitudes were generated using procedures based on 13-color photometry which differ from those used to produce predicted instrumental magnitudes in the SKYMAP System-based ground catalogs. Both prediction techniques, however, use an input magnitude in a known system and passband (e.g., the Johnson system's *V* passband), together with other information such as spectral type and/or observed colors, to produce a color index. This color index is used to convert the input magnitude to a predicted magnitude in the desired system and passband, which in the case of RXTE is that of the CT-601 star trackers. The resulting pre-launch OSC for RXTE contained 2,844 entries with predicted instrumental magnitudes in the range +1.0 to +6.5. Thirteen entries were corrected to center-of-light (COL) positions to account for the interference of nearby, bright neighboring stars.

Since that time, the MC has evolved considerably to reflect the availability of increasing amounts of higher-accuracy and better quality astronomical data. Revisions were produced on an approximately yearly basis, and as of this date, the MC has been through four major revisions since the Version 4.0 MC that was utilized in the creation of the pre-launch RXTE ground catalog. These revisions included:

- inclusion of astrometric and photometric data from the Hipparcos mission
- improvements to the content and completeness of the stellar spectral type data
- improvements to the content and completeness of the *ptv* (photovisual) and *ptg* (photographic) magnitude data
- improvements to the content and completeness of the near-neighbor data and identifiers
- improvements to the content and completeness of the variable star data and identifiers
- inclusion of CCDST measured magnitudes (from the CT-601 star trackers on RXTE and SWAS) for over 5000 stars
- improvements to the content and completeness of catalog cross-reference identifiers

The MMSCAT software has been updated and modified to include improved and expanded input stellar spectrophotometric scan data and to allow the use of CCDST magnitudes as input to the SKYMAP instrumental magnitude prediction subsystem. Analysis of CCDST data from flying missions has allowed refinement of the SKYMAP instrumental magnitude prediction algorithms and has improved the understanding of the performance of CCDSTs for stars with interfering near-neighbors.

CATALOGS PRODUCED

UPDATED GROUND STAR CATALOG (SKYMAP RUN CATALOG)

The ground star catalog for RXTE has been regenerated using the SKY2000 Version 3 Master Catalog and the latest version of MMSCAT. The resulting ground star catalog contains 16,205 entries with a predicted limiting instrumental magnitude brighter than +6.5 (no limit on the brighter end has been applied). The sensor resolution used in MMSCAT was 120.0 arcseconds, so that pairs and groups of stars separated by 120 arcseconds or less have been combined into single ground catalog entries with blended instrumental magnitudes and the positions of the brightest component in each pair or group. (See Figure 1 for an HST image of one example group containing five bright components represented collectively in the ground catalog by SKYMAP 12530185.) Analysis of RXTE and SWAS CT-601 data for inclusion in the SKY2000 MC has indicated that the 120-arcsecond radius is a better model of CT-601 performance than the 2.0-arcsecond value used prior to launch. Comparisons of pre-launch and updated ground star catalog predicted magnitudes to RXTE measured values (known as passband #3 magnitudes for the data field in which they appear in the SKY2000 V3 MC) are shown in Figures AA-1 and AA-2, respectively, in the Appendix. Figure AA-2 confirms that the current version of the MMSCAT software will return an RXTE CT-601 predicted magnitude without alteration when one is available as input from the SKY2000 MC (the calculated color index is zero in this case). In both figures, known or suspected variable stars have been removed, as instrumental magnitude predictions for them are obviously dependent on the epoch of the input magnitude used. Figure AA-3 shows a comparison of the predicted RXTE magnitudes in the updated ground star catalog to

Johnson *V* magnitudes in the MC. This figure includes all stars in both the OSC and the ground catalog and excludes known or suspected variable stars.

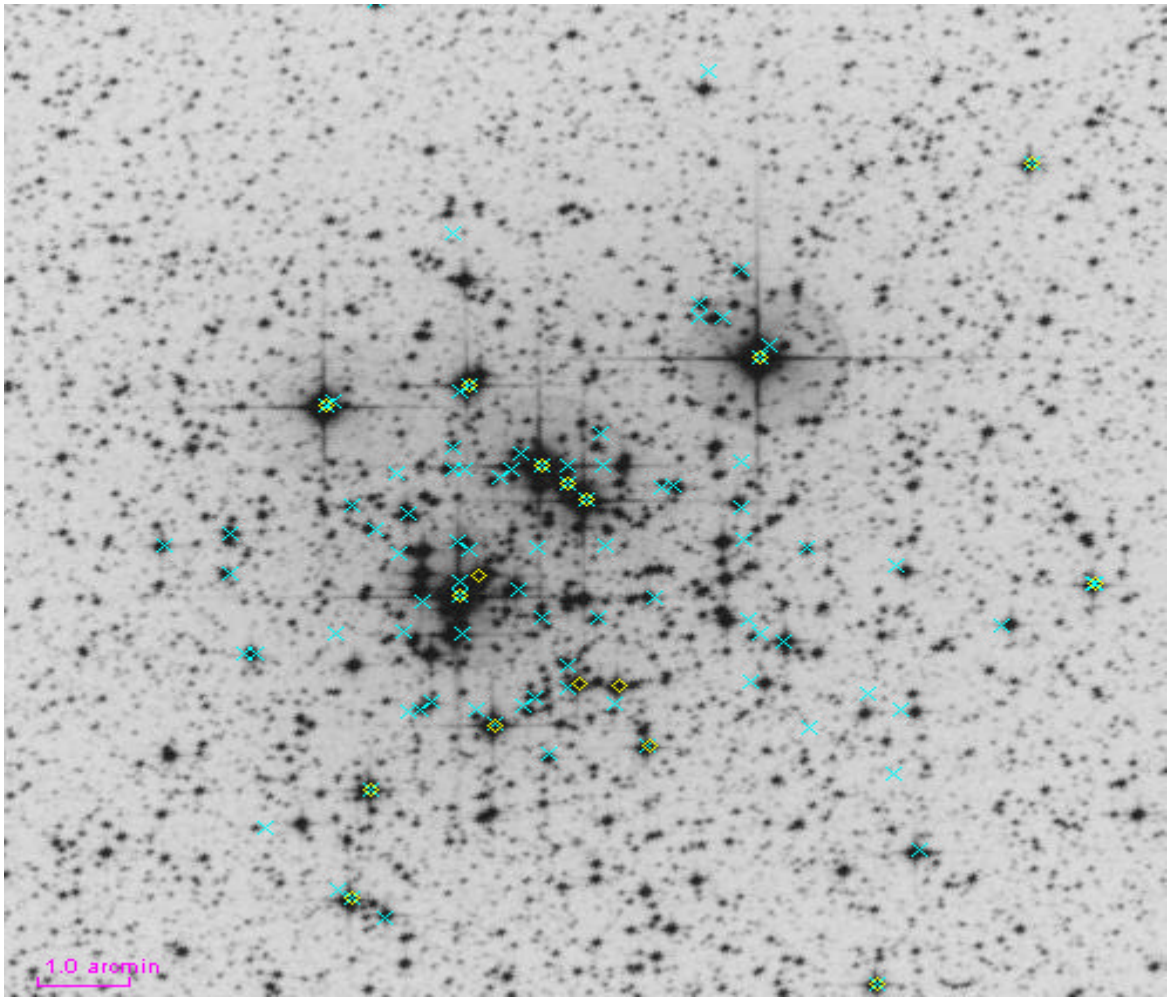

Figure 1. Open Cluster NGC 4755 (kap Cru) (image courtesy of CDS/STScI)

SKYMAP RUN CATALOG FORMAT AND QUALITY FLAG DEFINITIONS

Each RXTE ground catalog entry (see Table A-1 for the format of an entry) contains eight hexadecimal quality flags used to assist in determining the suitability of a given star as a potential guide star for attitude determination. Individual quality flags and the bin values selected during the generation of the updated RXTE Run Catalog are described in this section.

Table A-1. SKYMAP Run Catalog Record Format

<table>
<tr><th>Name</th><th>Type</th><th>Description</th></tr>
<tr><td>ISTDAT</td><td>I*4</td><td>SKYMAP number</td></tr>
<tr><td>FSTDAT(1)</td><td>R*4</td><td>X-component of GCI unit vector</td></tr>
<tr><td>FSTDAT(2)</td><td>R*4</td><td>Y-component of GCI unit vector</td></tr>
<tr><td>FSTDAT(3)</td><td>R*4</td><td>Z-component of GCI unit vector</td></tr>
<tr><td>FSTDAT(4)</td><td>R*4</td><td>Visual (V) or instrumental magnitude</td></tr>
<tr><td>FSTDAT(5)</td><td>R*4</td><td>Composite word (proper motion word):

Integer part—Direction of star’s total proper motion vector divided by 360.0, multiplied by 1000, and rounded to the nearest integer

Fractional part—Magnitude of star’s proper motion vector in arcseconds per year divided by 100</td></tr>
<tr><td>FSTDAT(6)</td><td>R*4</td><td>Composite word (quality flag word): Contains eight 4-bit flags used to quantify the quality of a star as a potential guide star; each flag measures the quality of a different physical aspect and includes the following:

<table>
<tr><th>Bits</th><th>Description</th></tr>
<tr><td>1-4</td><td>Variability</td></tr>
<tr><td>5-8</td><td>Color</td></tr>
<tr><td>9-12</td><td>Multiplicity</td></tr>
<tr><td>13-16</td><td>Near-neighbors</td></tr>
<tr><td>17-20</td><td>Position knowledge error</td></tr>
<tr><td>21-24</td><td>Magnitude knowledge error</td></tr>
<tr><td>25-28</td><td>Trackability near-neighbor (spare)</td></tr>
<tr><td>29-32</td><td>Identifiability near-neighbor (spare)</td></tr>
</table>
</td></tr>
<tr><td>FSTDAT(7)</td><td>R*4</td><td>Composite word (color word):

Integer part—(B-V) color multiplied by 100 and rounded to the nearest integer; = 999 if no (B-V) color is available

Fractional part—SKYMAP-coded spectral type divided by 100000</td></tr>
</table>

The first quality flag is the variability flag. It maps a star's variability amplitude in magnitudes as described in Table A-2. In general, this variability amplitude is not the amplitude of variability in the sensor passband of a particular CCDST. Rather, it is the observed variability in a particular astronomical passband (e.g., Johnson *V*). However, this amplitude can be used to obtain a rough idea of the degree of variability of a particular star.

Table A-2. Run Catalog Quality Flag 1 Definition (Variability)

Flag Value	Definition
0	0.0 = amplitude < 0.1
1	0.1 = amplitude < 0.2
2	0.2 = amplitude < 0.3
3	0.3 = amplitude < 0.4
4	0.4 = amplitude < 0.5
5	0.5 = amplitude < 0.75
6	0.75 = amplitude < 1.0
7	1.0 = amplitude < 2.0
8	2.0 = amplitude < 3.0
9	3.0 = amplitude < 4.0
10	4.0 = amplitude < 5.0
11	5.0 = amplitude < 6.0
12	6.0 = amplitude < 8.0
13	8.0 = amplitude < 10.0
14	Amplitude = 10.0
15	Known variable with unknown amplitude

The second quality flag is the color flag. It maps the difference between the input magnitude on a standard astronomical passband (e.g., Johnson *V*) used to predict the sensor passband magnitude by MMSCAT, and the predicted sensor passband magnitude itself. This difference (in magnitudes) indicates the degree of difference between the input magnitude and the output magnitude prediction. Table A-3 describes the mapping used to assign values to this flag.

Table A-3. Run Catalog Quality Flag 2 Definition (Color)

Flag Value	Definition
0	-100.0 = color < 0.05
1	0.05 = color < 0.1
2	0.1 = color < 0.2
3	0.2 = color < 0.3
4	0.3 = color < 0.4
5	0.4 = color < 0.5
6	0.5 = color < 0.6
7	0.6 = color < 0.85
8	0.85 = color < 1.0
9	1.0 = color < 1.25
10	1.25 = color < 1.5
11	1.5 = color < 1.75
12	1.75 = color < 2.0
13	2.0 = color < 2.5
14	2.5 = color < 3.0
15	Color = 3.0

The third quality flag is the multiplicity flag. For stars that are known to be members of double- or multiple-star systems, it maps the magnitude difference (in magnitudes) between the two brightest components. See Table A-4 for a detailed description of the mapping of this quality flag.

Table A-4. Run Catalog Quality Flag 3 Definition (Multiplicity)

Flag Value	Definition
0	Not a multiple star or multiple star treated as a near-neighbor
1	Nearest star is either greater than or equal to 6.0 magnitudes fainter, or is less than 0.1 arcseconds away, or if definition of values 0 or 2-7 does not apply
2	4.0 = magnitude difference < 6.0
3	3.0 = magnitude difference < 4.0
4	2.0 = magnitude difference < 3.0
5	1.0 = magnitude difference < 2.0
6	0.5 = magnitude difference < 1.0
7	Magnitude difference < 0.5

The fourth flag is the near-neighbor flag. It maps net position uncertainties of primary stars (in arcseconds) as a result of interfering near-neighbor stars. Despite the fact that pairs or groups of stars closer together than 120 arcseconds have been blended in the Run Catalog, the quality of the position given for the brightest component of the pair or group is expected to be degraded in quality from what would be expected for a solitary star. Quality flag four attempts to model this degradation with an additional position uncertainty mapped in arcseconds. See Table A-5 for a detailed mapping of this quality flag.

Table A-5. Run Catalog Quality Flag 4 Definition (Near-Neighbor Position Interference)

Flag Value	Definition
0	-1.0 = additional position uncertainty < 0.0
1	0.0 = additional position uncertainty < 1.0
2	1.0 = additional position uncertainty < 2.0
3	2.0 = additional position uncertainty < 3.0
4	3.0 = additional position uncertainty < 4.0
5	4.0 = additional position uncertainty < 5.0
6	5.0 = additional position uncertainty < 6.0
7	6.0 = additional position uncertainty < 8.0
8	8.0 = additional position uncertainty < 10.0
9	10.0 = additional position uncertainty < 30.0
10	30.0 = additional position uncertainty < 50.0
11	50.0 = additional position uncertainty < 100.0
12	100.0 = additional position uncertainty < 200.0
13	200.0 = additional position uncertainty < 500.0
14	500.0 = additional position uncertainty < 1000.0
15	additional position uncertainty = 1000.0

The fifth flag is the position knowledge uncertainty flag. It maps the RMS position uncertainty (ICRS2000) contained in the MC (in arcseconds). The mapping used to assign values to this flag is described in Table A-6.

Table A-6. Run Catalog Quality Flag 5 Definition (Position Knowledge)

Flag Value	Definition
0	0.0 = position measurement uncertainty < 0.01
1	0.01 = position measurement uncertainty < 0.02
2	0.02 = position measurement uncertainty < 0.03
3	0.03 = position measurement uncertainty < 0.04
4	0.04 = position measurement uncertainty < 0.05
5	0.05 = position measurement uncertainty < 0.075
6	0.075 = position measurement uncertainty < 0.1
7	0.1 = position measurement uncertainty < 0.2
8	0.2 = position measurement uncertainty < 0.4
9	0.4 = position measurement uncertainty < 0.8
10	0.8 = position measurement uncertainty < 1.2
11	1.2 = position measurement uncertainty < 1.6
12	1.6 = position measurement uncertainty < 2.0
13	2.0 = position measurement uncertainty < 3.0
14	3.0 = position measurement uncertainty < 9999.0
15	Position measurement uncertainty = 9999.0

The sixth flag is the predicted magnitude knowledge uncertainty flag. It maps the uncertainties associated with predicted sensor passband magnitudes from MMSCAT. This uncertainty includes the initial uncertainty of the input magnitude used by MMSCAT and an estimate of the uncertainties associated with different methods of predicting sensor passband magnitudes used by MMSCAT. Table A-7 details the mapping used to assign values to this flag.

Table A-7. Run Catalog Quality Flag 6 Definition (Predicted Magnitude)

Flag Value	Definition
0	0.0 = magnitude error < 0.05
1	0.05 = magnitude error < 0.1
2	0.1 = magnitude error < 0.2
3	0.2 = magnitude error < 0.3
4	0.3 = magnitude error < 0.4
5	0.4 = magnitude error < 0.5
6	0.5 = magnitude error < 0.6
7	0.6 = magnitude error < 0.8
8	0.8 = magnitude error < 1.0
9	1.0 = magnitude error < 1.25
10	1.25 = magnitude error < 1.5
11	1.5 = magnitude error < 1.75
12	1.75 = magnitude error < 2.0
13	2.0 = magnitude error < 2.25
14	2.25 = magnitude error < 2.5
15	Magnitude error = 2.5

The seventh quality flag is the trackability near-neighbor flag. It maps the angle in degrees to the nearest star either brighter than or up to 2.4 magnitudes fainter than the Run Catalog star. Nearby stars can interfere with the ability of a star sensor to track a particular star, and this flag serves to indicate the presence of potentially interfering nearby stars. Table A-8 details the mapping used to assign values to this flag.

Table A-8. Run Catalog Quality Flag 7 Definition (Trackability)

Flag Value	Definition
0	Near-neighbor separation = 4.0
1	3.5 = near-neighbor separation < 4.0
2	3.0 = near-neighbor separation < 3.5
3	2.5 = near-neighbor separation < 3.0
4	2.0 = near-neighbor separation < 2.5
5	1.5 = near-neighbor separation < 2.0
6	1.0 = near-neighbor separation < 1.5
7	0.8 = near-neighbor separation < 1.0
8	0.7 = near-neighbor separation < 0.8
9	0.6 = near-neighbor separation < 0.7
10	0.5 = near-neighbor separation < 0.6
11	0.4 = near-neighbor separation < 0.5
12	0.3 = near-neighbor separation < 0.4
13	0.251 = near-neighbor separation < 0.3
14	0.034 = near-neighbor separation < 0.251
15	0.0 = near-neighbor separation < 0.034

The eighth flag is the identifiability near-neighbor flag. It maps the angle in degrees to the nearest star within 2.4 magnitudes of the Run Catalog star in brightness. A nearby star similar in brightness to a particular Run Catalog star can be confused with the Run Catalog star and tracked instead of the intended star. This quality flag serves to help identify potential situations of this sort. Table A-9 details the mapping used to assign values to this flag.

Table A-9. Run Catalog Quality Flag 8 Definition (Identifiability)

Flag Value	Definition
0	Near-neighbor separation = 4.0
1	3.5 = near-neighbor separation < 4.0
2	3.0 = near-neighbor separation < 3.5
3	2.5 = near-neighbor separation < 3.0
4	2.0 = near-neighbor separation < 2.5
5	1.5 = near-neighbor separation < 2.0
6	1.0 = near-neighbor separation < 1.5
7	0.8 = near-neighbor separation < 1.0
8	0.7 = near-neighbor separation < 0.8
9	0.6 = near-neighbor separation < 0.7
10	0.5 = near-neighbor separation < 0.6
11	0.4 = near-neighbor separation < 0.5
12	0.3 = near-neighbor separation < 0.4
13	0.251 = near-neighbor separation < 0.3
14	0.034 = near-neighbor separation < 0.251
15	0.0 = near-neighbor separation < 0.034

RECOMMENDATIONS FOR CATALOG USE

The Run Catalog delivered is an all-sky catalog (see Figure A-2). The density of the catalog varies in different regions of the sky, as the only cutoff applied to stars input from the SKY2000 V3 MC was in predicted instrumental magnitude.

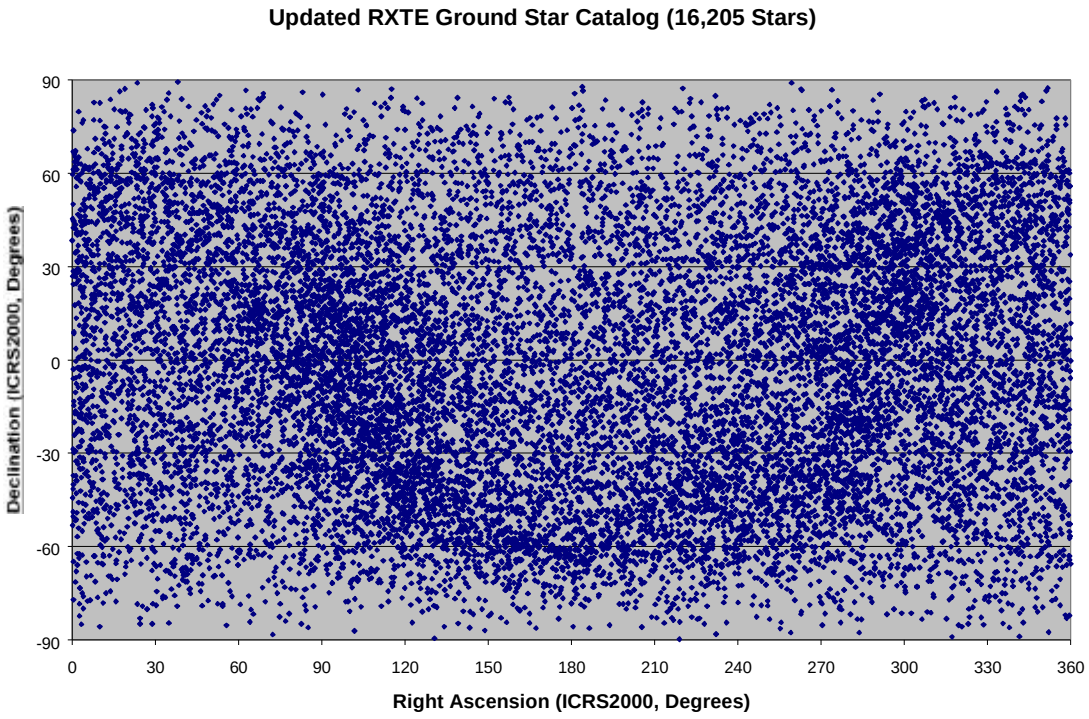

Figure A-2. RXTE Ground Catalog Star Positions

Variable stars are included in the RXTE ground catalog and can be identified by using quality flag 1 (variability amplitude, see Table A-2) in the Run Catalog. These stars are not recommended for use as guide stars due to the element of uncertainty involved when attempting to acquire and track them.

Quality flags seven and eight (near-neighbor interference) are based on stars present in the SKY2000 Version 3 MC. Stars not contained in the SKYMAP Master Catalog cannot be accounted for, and some of these stars are known to be bright enough for the RXTE CT-601 star trackers to detect (see the mention of star 23170077 in the following section).

As a result of the improvements to the content of the SKYMAP MC and to the instrumental magnitude prediction techniques of MMSCAT, a non-variable star with no measurable near-neighbor interference can be expected to produce magnitude residuals (difference of CT-601 measurement and SKYMAP prediction) of less than 0.25 magnitudes. This is expected to be the case for all tracked stars regardless of spectral type/color.

UPDATED ON-BOARD STAR CATALOG (RXTE OSC)

The OSC for RXTE has been largely regenerated using the SKY2000 Version 3 Master Catalog and some predicted instrumental magnitudes from the latest version of MMSCAT. The stars were not re-selected using the original, pre-launch criteria for inclusion or exclusion, so the updated OSC contains substantially the same stars as the original OSC, but with data of improved quality. See Table A-10 for a list of qualitative changes to the contents of the OSC.

Table A-10. Qualitatively Differing Entries in the Pre-Launch and Updated RXTE OSC

Old OSC ID	New OSC ID	Change	Notes
8560178/2037	9020106/3001	Replace	Original pos. wrong in MC v3.7, star also highly variable
23190077/2523	23270017/3002	Replace	23190077 has interfering, variable n-n not in MC
1390119	1390178	Modify	Double/multiple star, OSC i.d. unchanged, now agrees with SKY2K V3
2580038	2580135	Modify	Double/multiple star, OSC i.d. unchanged, now agrees with SKY2K V3
7080200	7080327	Modify	Double/multiple star, OSC i.d. unchanged, now agrees with SKY2K V3
7340159	7340280	Modify	Double/multiple star, OSC i.d. unchanged, now agrees with SKY2K V3
10190145	10200011	Modify	Double/multiple star, OSC i.d. unchanged, now agrees with SKY2K V3
10290093	10290094	Modify	Double/multiple star, OSC i.d. unchanged, now agrees with SKY2K V3
12410031	12410156	Modify	Double/multiple star, OSC i.d. unchanged, now agrees with SKY2K V3
12530059	12530170	Modify	Double/multiple star, OSC i.d. unchanged, now agrees with SKY2K V3
14230045	14230162	Modify	Double/multiple star, OSC i.d. unchanged, now agrees with SKY2K V3
14410025	14410169	Modify	Double/multiple star, OSC i.d. unchanged, now agrees with SKY2K V3
18510052	18510274	Modify	Double/multiple star, OSC i.d. unchanged, now agrees with SKY2K V3
21040020	21040202	Modify	Double/multiple star, OSC i.d. unchanged, now agrees with SKY2K V3
21190179	21190244	Modify	Double/multiple star, OSC i.d. unchanged, now agrees with SKY2K V3

The resulting updated OSC contains 2,844 stars with predicted instrumental magnitudes mainly between +1.0 and +6.5 (see Table A-11 for exceptions to the magnitude limits). Only one entry (19510175) is lacking *B*-*V* color and observed *V* magnitude data (a derived *V* magnitude is present). The following twelve pairs are represented by single entries with blended predicted instrumental magnitudes and positions corrected to COL

(the first identifier is the one retained in the updated OSC): 1390178/1390119, 1530079/1530157, 2030134/2030178, 2580135/2580038, 5210128/5210140, 10200011/10190145, 11290090/11290167, 12350014/12350129, 12410156/12410031, 13220097/13220154, 15560147/15560193, and 23190025/23190161.

Table A-11. Updated OSC Entries Outside Magnitude Limits

OSC ID	Magnitude	Notes
8220108	0.843	Spectroscopic binary, v3.7 MC spectral type for secondary star
360060	6.547	Poor v3.7 MC computed *V*?
4150057	6.554	Spectral type M, original magnitude prediction off?
8100137	6.545	Spectral type M, original magnitude prediction off?
9040020	6.645	Incorrect v3.7 MC observed *V*
13310119	6.669	Spectral type K, original magnitude prediction off?
19260129	6.526	Spectral type M, poor v3.7 MC computed *V*
22350132	6.555	Spectral type K, poor v3.7 MC computed *V*

The updated OSC retains some data from the original OSC, most importantly predicted instrumental magnitudes. The update process replaced the original OSC instrumental magnitude prediction with an observed RXTE (or converted SWAS) CT-601 magnitude if such was available for all stars. For the remaining stars, updated SKYMAP predictions were used for stars with *B*-*V* colors of +1.30 or greater (see Figures AA-3 through AA-6) because the original OSC magnitude prediction process differed for these stars from what was used for stars blueward of approximately this point. For stars not falling into either of these categories, SKYMAP predictions were used in cases where the v3.7 MC *V* and/or *B*-*V* color differed from what is currently in the SKY2000 V3 MC by 0.25 magnitudes or more (usually indicating blending or erroneous values in the v3.7 entry). Finally, if none of the preceding cases applied, the original OSC magnitude was written to the updated OSC. See Figure AA-7 for a comparison of the final magnitude predictions between the updated RXTE OSC and the updated RXTE SKYMAP ground catalog.

RXTE OSC FORMAT AND QUALITY FLAG DEFINITIONS

The format of the updated OSC has not changed from that used originally, although the content of each field may have changed somewhat. Table A-12 describes the format of a data record in the updated OSC, while Tables A-13 through A-16 describe the mappings of OSC quality flags that were updated.

Table A-12. Updated RXTE OSC Record Format

Name	Bytes*	Units	Description
SKYMAP ID	4-11		SKYMAP SKY2000 V3 Master Catalog identifier
OSC ID	13-16		On-board Star Catalog identifier
Right Ascension	19-26	deg	ICRS2000 Right Ascension (functionally the same as J2000)
Declination	29-36	deg	ICRS2000 Declination
R.A. Proper Motion	37-45	deg/yr	ICRS2000 Right Ascension proper motion
Dec. Proper Motion	46-54	deg/yr	ICRS2000 Declination proper motion
B-V Color	57-62	mag	Johnson *B* minus *V* color
V Observed	65-70	mag	Observed Johnson *V* magnitude
V Computed	73-78	mag	Computed Johnson *V* magnitude (if observed not available, else same)
Spectral Type	80-84		SKYMAP-coded spectral type
Variability Ampl.	86-93	mag	Amplitude of variability (in *V* passband, 0.0 if other or ampl. not known)
Nearest neighbor	95-101	deg	Angle from this star to nearest neighboring SKY2000 V3 MC star
Predicted Instr. Mag.	104-109	mag	Predicted CT-601 CCDST magnitude
Quality Flags	112-117		Quality flags 1: Data version (satisfied initial selection criteria) 2: Predicted CCDST magnitude 3: Variability amplitude 4: Proper motion magnitude 5: Near-neighbor proximity, magnitude difference 6: Method of computation for CCDST magnitude
Quality Flag	125		Overall quality flag 1: High (data version and near-neighbor q.f.s both zero) 2: Low (else)
*All preceding or intervening bytes are blank.			

The first quality flag field in the OSC is a six-byte field containing leading blanks. The first quality flag is the initial selection criteria flag and has not been altered from what was contained in the pre-launch OSC. The second quality flag maps the brightness in the instrumental passband of an OSC star. Table A-13 describes the mapping of values for this quality flag.

Table A-13. Updated OSC Instrumental Magnitude Flag

Flag Value	Definition
0	0.0 < predicted instrumental magnitude = 2.0
1	2.0 < predicted instrumental magnitude = 3.0
2	3.0 < predicted instrumental magnitude = 4.0
3	4.0 < predicted instrumental magnitude = 5.0
4	5.0 < predicted instrumental magnitude = 6.0
5	6.0 < predicted instrumental magnitude

The third quality flag maps the variability amplitude of an OSC star. It is set to 0 for stars not known or suspected of variability (based on the SKY2000 V3 MC). It is also set to 0 for stars with amplitudes of variability in SKY2000 V3 in passbands other than the Johnson *V* passband or for known or suspected variable stars with unknown amplitudes of variability (including those coded "constant" in variable star catalogs). Stars with known variability amplitudes in the Johnson *V* passband are mapped as described in Table A-14.

The fourth quality flag maps the RMS proper motion of an OSC star. The units are arcseconds per year, and the values are at ICRS2000. There are no OSC stars lacking proper motions. Table A-15 describes the mapping of flag values to values of RMS proper motion.

The fifth quality flag is a near-neighbor flag that includes both proximity and brightness differences between a given OSC star and other nearby stars. This quality flag was not remapped in the update of the OSC due to lack of appropriate data. The sixth quality flag maps the computational source of the predicted CCDST magnitude in the updated OSC. Table A-16 describes the mapping of this quality flag.

Table A-14. Updated OSC Variability Amplitude Flag

Flag Value	Definition
0	Not a known or suspected variable, or variability amplitude not in Johnson *V* passband, or variability amplitude unknown
1	0.0 < variability amplitude = 0.25
2	0.25 < variability amplitude = 0.5
3	0.5 < variability amplitude = 0.75
4	0.75 < variability amplitude = 1.0
5	1.0 < variability amplitude = 1.25
6	1.25 < variability amplitude = 1.5
7	1.5 < variability amplitude = 1.75
8	1.75 < variability amplitude = 2.0
9	2.0 < variability amplitude

Table A-15. Updated OSC RMS Proper Motion Flag

Flag Value	Definition
0	0.0 < RMS proper motion = 0.5
1	0.5 < RMS proper motion = 1.0
2	1.0 < RMS proper motion = 1.5
3	1.5 < RMS proper motion = 2.0
4	2.0 < RMS proper motion = 2.5
5	2.5 < RMS proper motion = 3.0

Table A-16. Updated OSC CCD Magnitude Computation Flag

Flag Value	Definition
0	Original OSC (observed *V*, *B-V* color)
1	Original OSC (computed *V*, *B-V* color)
2	Original OSC (observed *V*, spectral type)
3	Original OSC (computed *V*, spectral type)
4	Original OSC (6500 < coded spectral type < 8000)
5	Original OSC (no CCD magnitude prediction)
6	Updated OSC (RXTE or SWAS observed)
7	Updated OSC (MK spectral type, spectrophotometric scan)
8	Updated OSC (as 7, but no correction for reddening)

RECOMMENDATIONS FOR CATALOG USE

As the original RXTE OSC was, the updated OSC is an all-sky catalog (see Figure A-3). The density of the catalog in different regions of the sky is more nearly uniform than that of the updated SKYMAP ground catalog due to selection criteria imposed during the creation of the original OSC.

Variable stars with relatively small amplitudes of variability are included in the updated RXTE OSC. Inasmuch as the SKY2000 V3 MC is known to be incomplete in both variable star identifiers and in variability data, it is highly probably that at least some of the RXTE OSC stars not presently identified as variable are indeed variable. (Some of the outlier points on the magnitude difference plots are likely to be variable stars.)

Near-neighbor data in the RXTE OSC are as complete as available data permit. Stars not contained in the SKY2000 V3 MC cannot be taken into account (e.g., 23170077 in the pre-launch OSC is 3.5 arcminutes away from BE And, a highly variable red star bright enough to be separately detectable by a CT-601 CCDST, but not contained in the SKYMAP Master Catalogs). Furthermore, because the initial selection criteria were not reapplied, some stars retained in the OSC have characteristics as guide stars that would make them less than optimal for use on-board (e.g., 10200011 is 5.5 arcminutes away from AD Leo, a moderately variable red star in the SKY2000 V3. 10200011 has not been replaced because of the relatively large angle involved and the fairly large magnitude difference between the 10200011/10190145 blend and AD Leo).

Approximately 50% of all stars in the updated RXTE OSC now have magnitudes measured by CT-601 star trackers and placed onto the photometric system defined by the RXTE star trackers in the predicted instrumental magnitude field. This proportion could be increased by careful substitution of observed values from mission data into the catalog for stars that do not now have measured CT-601 magnitudes.

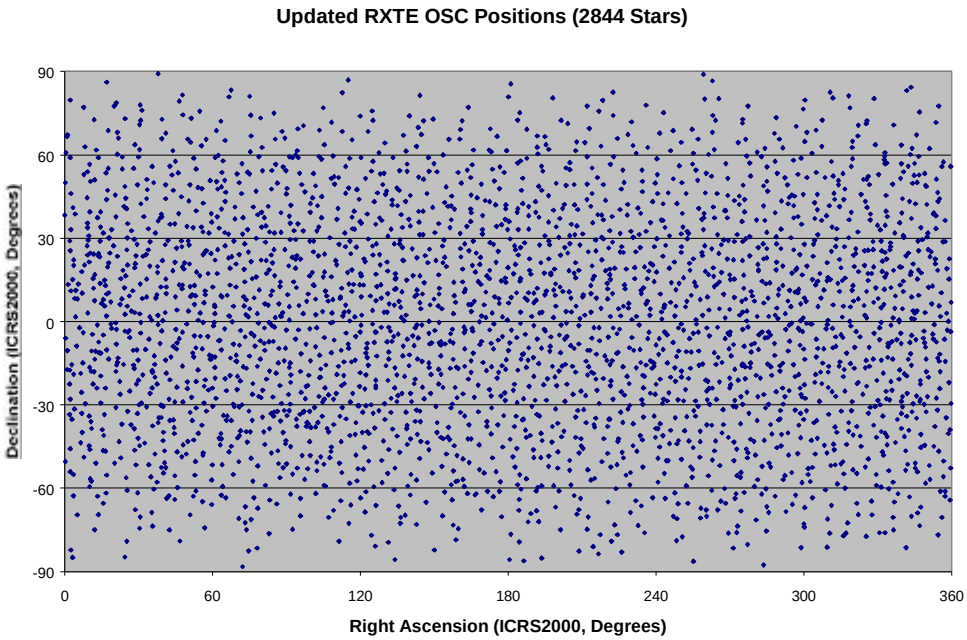

Figure A-3. RXTE OSC Star Positions

Appendix: Predicted Magnitudes in the RXTE OSC and Ground Catalogs

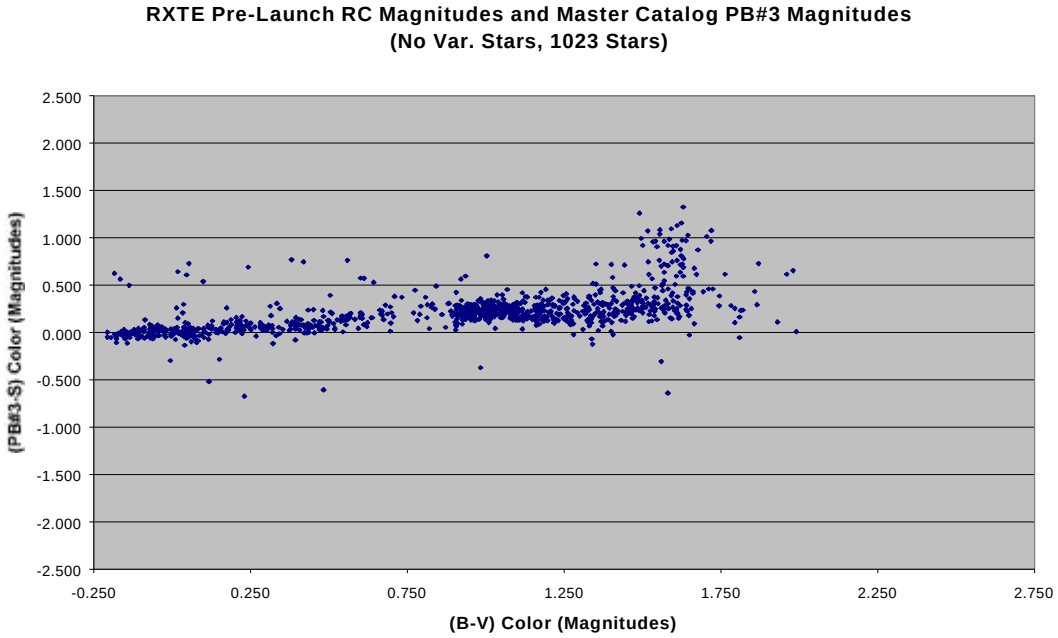

Figure AA-1. Pre-Launch Ground Catalog Predicted Magnitudes and RXTE Measured Magnitudes

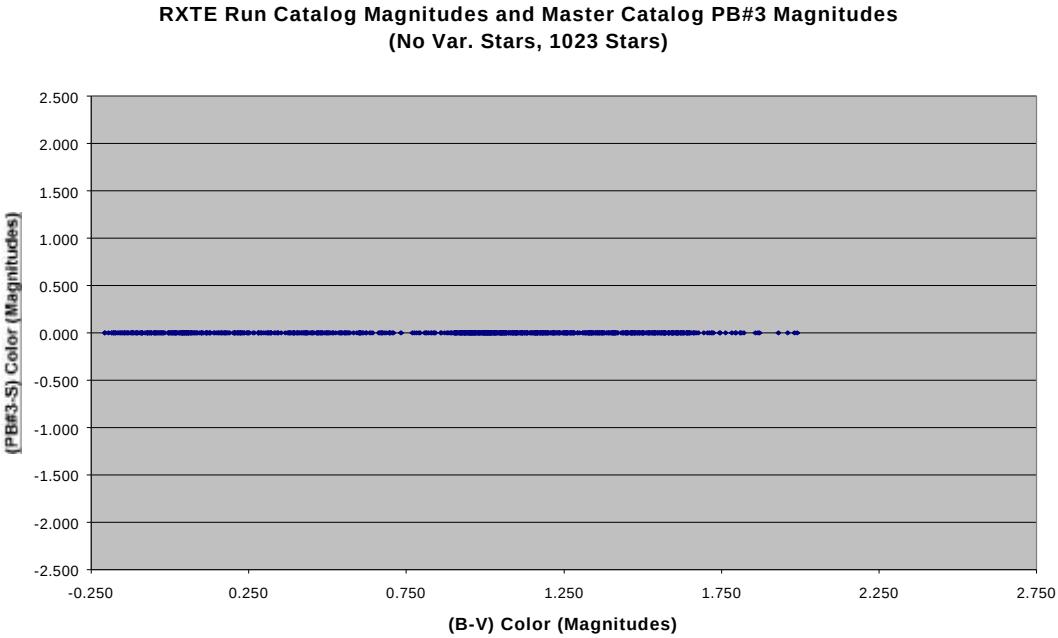

Figure AA-2. Updated Ground Catalog Predicted Magnitudes and RXTE Measured Magnitudes

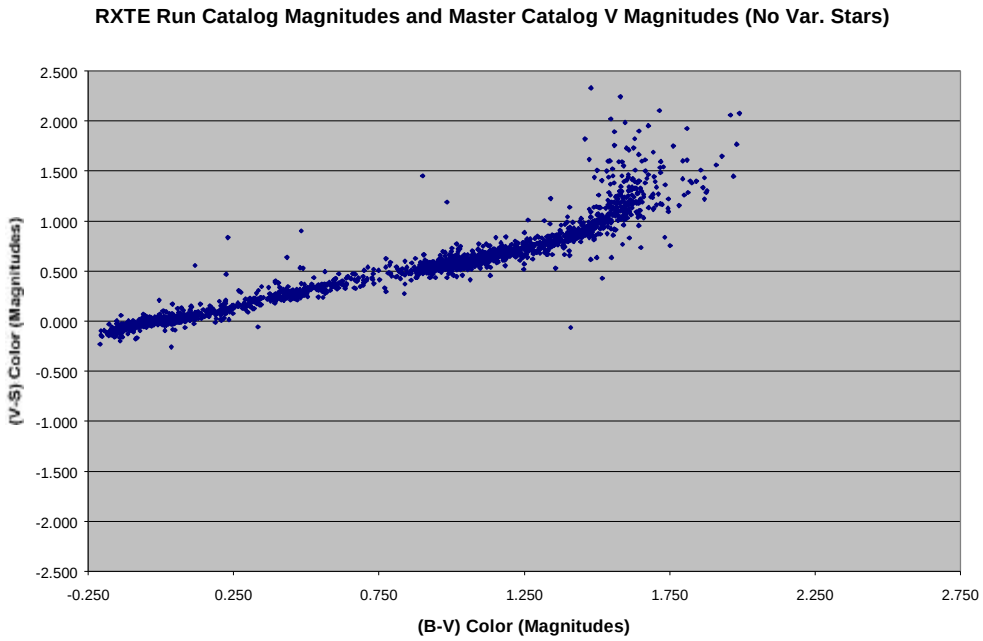

Figure AA-3. Updated Ground Catalog Predicted Magnitudes and SKY2000 V3 MC Johnson *V* Magnitudes

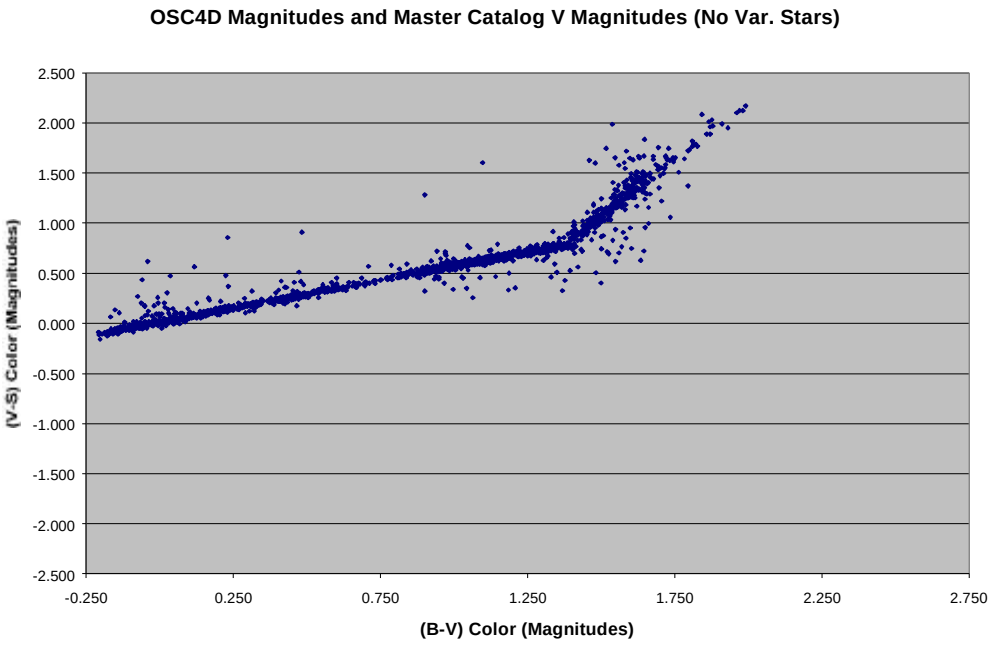

Figure AA-4. Pre-Launch OSC Predicted Magnitudes and SKY2000 V3 MC Johnson *V* Magnitudes

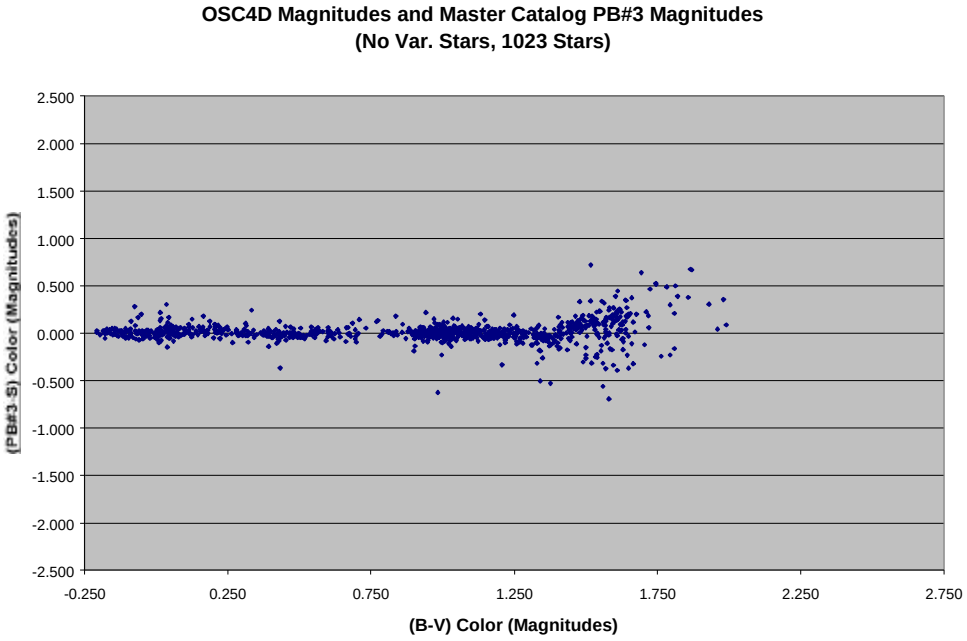

Figure AA-5. Pre-Launch OSC Predicted Magnitudes and RXTE Measured Magnitudes

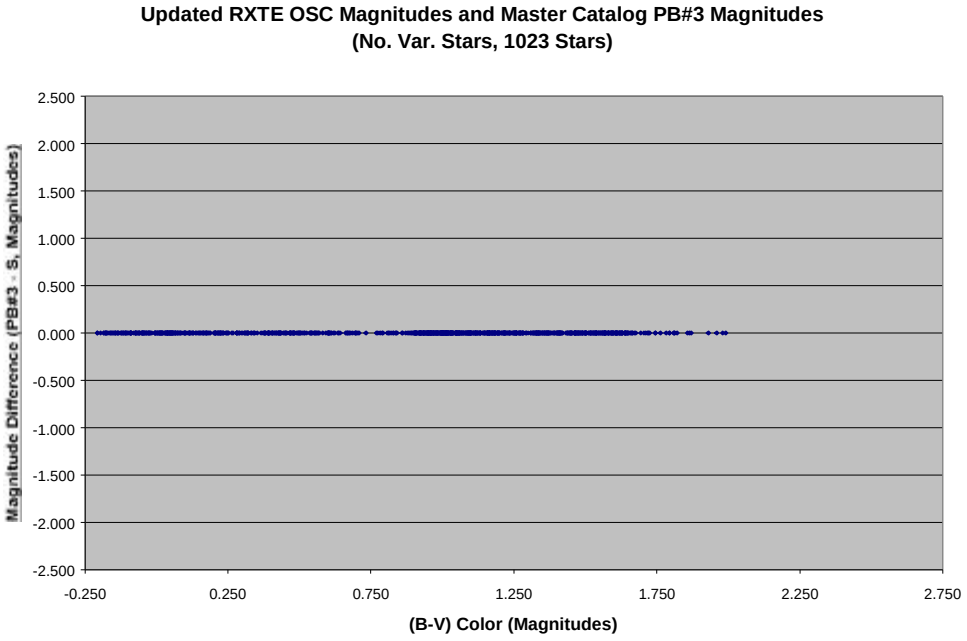

Figure AA-6. Updated OSC Predicted Magnitudes and RXTE Measured Magnitudes

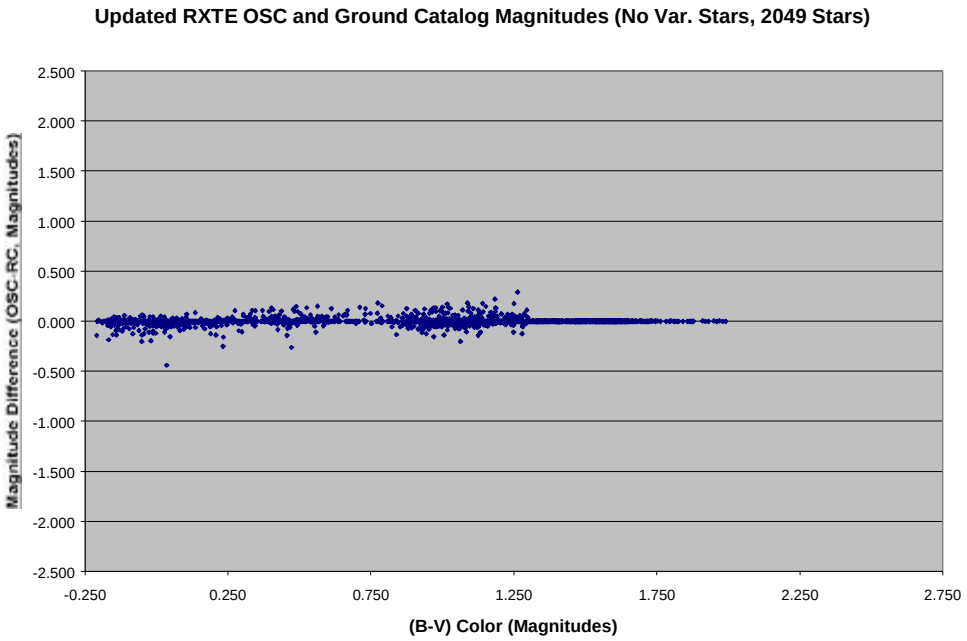

Figure AA-7. Updated OSC and Ground Catalog Predicted Magnitudes